International Journal of Pharmacy and Pharmaceutical Sciences

ISSN- 0975-1491 Vol 10, Issue 2, 2018

Original Article

ANTIBACTERIAL CAPACITY AND IDENTIFICATION OF BIOACTIVE COMPOUNDS BY GCMS OF *ALLIUM CEPA*

DUSHYANT SHARMA, REENA RANI, MONIKA CHATURVEDI, J. P. YADAV*

Department of Genetics, Maharshi Dayanand University, Rohtak, Haryana, India 124001
Email: yadav1964@rediffmail.com

Received: 16 Nov 2017 Revised and Accepted: 21 Dec 2017

ABSTRACT

Objective: Plants offer a novel source for the isolation of a wide variety of medicinal agents. *Allium cepa* commonly known as onion is very well known medicinal plants and we investigated the antibacterial activity of different extracts and their phytochemical analysis by gas chromatography mass spectrometry (GCMS).

Methods: The extracts of *A. cepa* prepared in six different solvents was analyzed for antibacterial activity against nine American type cell culture (ATCC) reference bacterial strains i.e. *Shigella flexneri*, *Enterococcus faecalis, Staphylococus aureus*, *Proteus mirabilis, Salmonella typhi*, *Serratia marcescens*, *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas aeruginosa* by using the agar well diffusion method. GCMS analysis also has been carried out for their phytochemical analysis.

Results: The results obtained from agar well diffusion assay showed the zone of inhibition range from 10±0.76 to 26±0.76 mm for different extracts. The methanol extract was found most potent against *K. pneumonia* and *S. marcescens* with the zone of inhibition of 26±0.76 mm for both strains. Minimum inhibitory concentration (MIC) values were in the range of 1.87 to 7.5 mg/ml and the MIC values for *K. pneumonia* and *S. marcescens* was 1.87 mg/ml. A total of 43 compounds were identified by GCMS analysis. Out of them dodecanoic acid was found common in all extracts.

Conclusion: It is concluded that *Allium cepa* have good antibacterial activity so it can be used for the treatment of various infectious diseases.

Keywords: Antibacterial activity, GCMS, *Allium cepa*, Bioactive compounds

DOI: http://dx.doi.org/10.22159/ijpps.2018v10i2.23698

INTRODUCTION

Medicinal plants are being used for the treatment of different kind of diseases since ancient times. Plants synthesize a number of chemical compounds which are not directly involved in plant growth, but responsible for the different biological activities and provide protection from predators such as insects, fungi and herbivorous [1]. These chemicals are known as secondary metabolites. The secondary metabolites isolated from plants act in the human body in the similar way of the chemical compounds of allopathic drugs in their mechanism of action [2] Moreover, day by day the pathogens are being resistant against the synthetic drug, due to which herbal medicines can be an effective source for treatment of diseases with lesser side effects [3-4].

A. cepa has been used as spices, vegetables, ornamentals and as medicines for curing and treatment of various diseases. The *Allium* genus comprises of more than 700 species, widely distributed all over the world [5] and known for their flavor, easy growth and long storage time. It is one of the civilization's oldest medicines and described as the dynamite of natural foods. *Allium* species are characterized by their rich content of sulfur compounds that are responsible for their organoleptic characteristics [6-7] and contributes to the antioxidant and antimicrobial activities [8]. Many studies have been done for its uses in the treatment of different diseases. The bulb is the main and most commonly used part of the onion. The bulb of *A. cepa* has been reported to possess various activities like antihelmintic, antibacterial, anti-inflammatory, antiseptic, antispasmodic, carminative, diuretic, expectorant, febrifuge, hypoglycemic, hypotensive, lithintropic, stomachic and tonic [9-11]. Quercetin is one of the major flavanol beside other phytochemicals present in the *A. cepa* which has antioxidant, antibacterial, urease inhibition and anti melanogenesis activities [12-13]. Diallyl disulphide, polyphenols and anthocyanins are the other major components present in *A. cepa* [14].

Keeping in view of the importance of this plant, the present study has been carried out to check the antibacterial activity of different extracts of *A. cepa* against different bacteria. GCMS analysis also has been carried out for their phytochemical analysis.

MATERIALS AND METHODS

Chemicals and reagents

Nutrient agar, peptone water and streptomycin discs were purchased from HiMedia, India. Resazurin was purchased from Sigma-Aldrich Chemicals Private Limited, India. The solvents used for the preparation of plant extracts were purchased from sisco research laboratory (SRL), India. All solvents and chemicals, purchased were of analytical grade.

Preparation of plant extracts

Onions (red type) were purchased from the local market of Rohtak (28.8909 °N and 76.5796 °E), Haryana, India. These were peeled off, followed by washing and subjected to shade dry. The dried material was ground in an electrical grinder to obtain powder form. The powdered material (50 gms) was extracted with six organic solvents i.e. acetone, benzene, chloroform, ethyl acetate, methanol, and petroleum ether (1:10) using cold percolation for 48-72 h. The obtained extracts were filtered using Whatman No. 1 filter paper and then concentrated using rotary evaporator at 40 °C.

Antibacterial activity

The antibacterial activity of the extracts was analyzed against nine different american type cell culture (ATCC) reference bacterial strains i.e. *Shigella flexneri* ATCC 12022, *Enterococcus faecalis* ATCC 29212, *Staphylococus aureus* ATCC 259323, *Proteus mirabilis* ATCC 43071, *Salmonella typhi* ATCC 13311, *Serratia marcescens* ATCC 27137, *Klebsiella pneumonia* ATCC 700603, *Escherichia coli* ATCC 25922, *Pseudomonas aeruginosa* ATCC 27853 by using agar well diffusion method of Perez *et al.* (1990) with slight modifications [15]. The bacterial strains were obtained from Department of microbiology of Pt. B. D. Sharma University of Health Sciences, Rohtak, Haryana, India.

Minimum inhibitory concentration (MIC)

MIC was determined using micro broth dilution method using 96 multi-well microtitre plates following the method of Sarker *et al.*

(2007) with slight modifications [16]. Resazurin was used as indicator dye (270 mg/40 ml dH_2O), purple colour of indicator dye reduced in the presence of living bacteria into pink/colourless. In the absence of living bacteria the colour of the indicator remains purple. The lowest concentration at which colour change occurred was taken as MIC.

GCMS analysis

Phytochemical analysis of all six extracts of *A. cepa* was carried out using GCMS analyzer (BRUKER SCION 436-GC SQ). Extracts were dissolved in methanol (HPLC grade) and filtered through Whatman™ FILTER DEVICE (0.2 µm). Helium (99.99%) was used as carrier gas, at flow rate of 1 ml per minute in split mode. RESTEK Rtx®-5 (Crossbond® 5% diphenyl/95% dimethyl polysiloxane) with 30 m length, 0.25 µm df and 0.25 mm ID column was used for separation of phytochemicals. 2 µl of the sample was injected to the column. The injector temperature was 280 °C. The temperature of oven was started at 70 °C and hold for 2 min and then raised at a rate of 7 °C per minute up to 320 °C; hold for 1 min. Temperature of ion sources was maintained at 250 °C. The mass spectrum obtained by electron ionization at 70eV and detector operates in scan mode 30 to 500 Da atomic units. Total running time was 38.71 min including 3 min solvent delay.

RESULTS AND DISCUSSION

Yield of extracts

The measured yield of the extracts and % age of extracted values have been given in table 1.

Table 1: The yield of *A. cepa* extracts and %age of extracted value

S. No.	Extracts	Yield of extracts (g)	%age of extracted value (Quantity of extract obtained × 100/Weight of dried powder)
1	Methanol	5.68	11.36
2	Acetone	4.69	9.38
3	Ethyl acetate	3.45	6.9
4	Chloroform	0.870	1.5
5	Benzene	0.746	1.4
6	Petroleum ether	0.480	0.96

Antibacterial activity

In the present study antimicrobial activities of extracts of *A. cepa* was investigated against reference bacterial strains at different concentrations by agar well diffusion assay. All the extracts showed good antibacterial activity with the zone of inhibition diameter ranging from 10 to 26 mm for different bacteria (table 2). The methanol extract showed highest antibacterial activity at all concentration as compared to other different extracts. Methanol extract of *A. cepa* showed concentration dependent activity. The concentration of 40 mg/ml was found to be more effective. Highest zone of inhibition was reported against *K. pneumonia* ATCC 700603 and *S. marcescens* ATCC 27137. Similarly, acetone extract showed 17 mm and 15 mm zone of inhibition against *S. flexneri* ATCC 12022 and *E. coli* ATCC 25922 respectively. The outcomes of our study indicate that *A. cepa* have significant antimicrobial potential which supports the study of Palaksha *et al.*, [17]. It has been reported that the antimicrobial activity of *A. cepa* due to the presence of organo-sulfur and phenolic compounds [18].

Antibacterial activity of extracts of *A. cepa* has been analyzed against *Bacillus subtillis* and *S. aureus* by Sable *et al.* and the zone of inhibition measured were 8 mm and 9 mm respectively. *A. cepa* extract in combination with *Zingiber officinale* extract showed the zone of inhibition of 13 mm and 11 mm against *B. subtillis* and *S. aureus* respectively [19]. Thus, the synergistic effects may increase the potential of the *A. cepa*. Antagonistic effect of the onion extracts has been checked against bacterial isolates i.e. *E. coli*, *S. aureus*, *Streptococcus pneumonia* and *Streptococcus pyogenes* with the inhibition zone of 17, 19, 17 and 20 mm respectively [20]. Kim *et al.* have studied the effect of *A. cepa* extracts on the oral pathogenic bacteria i.e. *Streptococcus mutans*, *Streptococcus sobrinus*, *Porphyromonas gingivalis* and *Prevotella intermedia* and found that extracts were active against all of these bacteria [21]. Shakurfow *et al.* have analyzed the antibacterial activity of cold water and organic solvent extracts against *Listeria monocytogenes* and found that the cold water extract was more effective than the organic solvent extract [22]. Santas *et al.* have checked the antibacterial activity of ethyl acetate extract of *A. cepa* against four Gram+ve (*Bacillus cereus*, *S. aureus*, *Microcroccus luteus* and *Listeria monocytogenes*) and two Gram–ve bacteria (*E. coli* and *P. aeruginosa*).

They observed that the extract inhibit the Gram+ve bacteria effectively while Gram-ve were found resistant [23]. On the contrary, in the present study the methanol extract of *A. cepa* was more effective against the Gram–ve bacteria.

Table 2: The zone of inhibition in mm against different bacterial strains

Bacterial strain	Methanol	Acetone	Ethyl acetate	Chloroform	Petroleum ether	Benzene	Streptomycin
S. flexneri	20±0.76*	17±1.00	10±0.57	-	14±0.57	-	21±0.57
E. feacalis	14±0.57	13±1.00	10±0.76	11±1.00	12±1.00	11±0.57	23±0.57
S. aureus	16±0.76	-	12±0.76	-	12±1.00	-	26±0.76
P. mirabilis	20±0.57	-	-	11±0.57	-	11±0.76	23±1.00
S. typhi	15±1.00	12±0.57	-	-	-	-	19±1.00
S. marcescens	26±0.76	11±0.76	10±1.00	12±0.57	10±0.76	12±0.76	20±0.57
K. pneumonia	26±0.76	10±0.57	17±1.00	-	10±0.57	-	19±0.57
E. coli	23±0.76	10±0.57	12±0.57	10±0.76	-	-	18±0.57
P. aeruginosa	20±0.57	15±1.00	10±0.57	12±0.57	-	-	23±0.76

*The zone of inhibition showed as mean±Standard deviation (n=3)

MIC values of different extracts against tested microbes have been shown in table 3. The results showed that MIC values of *A. cepa* extracts varied from 1.87 mg/ml to 7.50 mg/ml. Lowest MIC value was observed for methanol extract (1.87 mg/ml) against *K. pneumoniae* and *S. marcescens*. It means that *A. cepa* methanol extract possess the highest antimicrobial activity as compared to other extracts.

Table 3: MIC values (in mg) of different extracts against different bacteria

Bacterial strain	Methanol	Acetone	Ethyl acetate	Chloroform	Petroleum ether	Benzene
S. flexneri	5.0	3.75	7.5	-	3.75	-
E. feacalis	3.75	5.0	7.5	7.5	5.0	5.0
S. aureus	7.5	-	5.0	-	5.0	-
P. mirabilis	3.75	-	-	7.5	-	5.0
S. typhi	-	7.5	-	-	-	-
S. marcescens	1.87	7.5	7.5	5.0	7.5	5.0
K. pneumonia	1.87	7.5	3.5	-	7.5	-
E. coli	7.5	7.5	5.0	7.5	-	-
P. aeruginosa	5.0	5.0	3.75	5.0	-	-

The MIC values are showed as mean (n=3)

GCMS analysis

Organic compounds of different extracts were identified by GCMS analysis and spectra result was matched with the National Institute of Standards and Technology (NIST) MS library. The lists of identified phytochemicals from different extracts (methanol, acetone, ethyl acetate, chloroform, benzene, petroleum ether) have been given in table 4. The main phytochemicals identified by matching the spectra with NIST library were dodecanoic acid, methyl tetradecanoate, tetradecanoic acid, pentadecanoic acid, 14-methyl-, methyl ester, methyl stearate, eicosanoic acid, methyl ester, di(2-ethylhexyl)adipate, 9-octadecenamide, (Z), 9-octadecenamide, (Z), tetracontane, 3,5,24-trimethyl, beta.-sitosterol. The spectra of the GCMS are given in fig. 1-6. The GCMS analysis revealed the presence of fatty acids and esters. Many fatty acids isolated from plants have been reported for their antimicrobial activity. Dodecanoic acid, also known as lauric acid has been isolated from coconut oil possesses good antibacterial activity against *S. aureus*, *Bacillus cereus*, *Salmonella thypimurium* and *E. coli* [24]. Pthalic acid, also known as benzoic acid has been tested against bacterial strain and zone of inhibition were ranged from 15 to 18 mm [25]. Odiba *et al.* had extracted the beta sitostirol from honey bee *Propolis* and studied its antibacterial activity against *P. aeruginosa*, *E. coli*, *K. pneumonia*, *S. aureus*, *Streptococcus pyrogenes*, *Corynebacterium ulcerans*, *Bacillus subtillis*, *Shigella dysentariae*, *P. mirabilis*, *Candida albicans*, *Candida krusei* and *Candida tropicalis*. They concluded that beta sitosterol showed the good antibacterial activity [26]. We have also reported the presence of beta sitosterol in *A. cepa* extracts. The GCMS analysis of extracts showed the existence of volatile compounds which are comparable to the study done by Lekshmi *et al.* [27]. The similar compounds reported in our study are octadecanoic acid, undecane, sitosterol, tetradecanal, dibutyl phthalate etc. Farag *et al.* identified the 39 volatile compounds from *A. cepa* and *A. sativum* using solid-phase micro-extraction coupled to GCMS and 38 non-volatile compounds by using UPLC/PDA/orbitrap-MS in methanol extracts [28]. In our study, most of the compounds identified in all six extracts were almost similar. However their quantities may differ as revealed from peak area and % of total. Maximum numbers of compounds (25) were identified in chloroform extract using NIST library.

Table 4: Phytoconstituents of six extracts screened by GCMS analysis with area and % of total

Name of compounds	Area						% of total						Formula
	ACM	ACA	ACEA	ACC	ACPE	ACB	ACM	ACA	ACEA	ACC	ACPE	ACB	
Dodecanoic acid, methyl ester	6.501e+7	6.490e+7	5.116 e+7	6.910e+7	5.934e+7	7.648e+7	10.016	12.909	7.422	6.798	8.650	6.284	$C_{13}H_{26}O_2$
Dodecanoic acid	2.912e+8	4.592e+7	9.358 e+7	1.230 e+8	7.029 e+7	1.293e+8	44.860	9.133	13.576	12.097	10.247	10.626	$C_{12}H_{24}O_2$
Methyl tetradecanoate	3.041e+7	3.224e+7	-	3.763 e+7	-	-	4.685	6.414	-	3.702	-	-	$C_{15}H_{30}O_2$
Tetradecanoic acid	5.040e+7	1.441e+7	-	1.505 e+7	1.088 e+7	-	7.766	2.867	-	1.481	1.587	-	$C_{14}H_{28}O_2$
Phthalic acid, hex-3-yl isobutyl ester	7.923e+6	-	-	-	-	-	1.221	-	-	-	-	-	$C_{18}H_{26}O_4$
Pentadecanoic acid, 14-methyl-, methyl ester	6.338e+7	7.851e+7	-	-	4.510 e+6	-	9.766	15.617	-	-	0.657	-	$C_{17}H_{34}O_2$
9,12-Octadecadienoic acid, methyl ester, (E,E)	5.744e+7	-	1.964 e+8	-	-	-	8.850	-	28.492	-	-	-	$C_{19}H_{34}O_2$
Methyl stearate	1.053e+7	-	1.966 e+7	2.231 e+7	20.22e+7	2.555e+7	1.622	-	2.853	2.195	2.948	2.099	$C_{19}H_{38}O_2$
Tetracontane, 3,5,24-trimethyl	8.674e+6	-	9.829 e+6	-	-	-	1.336	-	1.426	-	-	-	$C_{43}H_{88}$
1-Decanol, 2-hexyl	1.006e+7	-	-	-	-	3.214e+7	1.550	-	-	-	-	2.641	$C_{16}H_{34}O$
Eicosanoic acid, methyl ester	5.628e+6	-	1.531 e+7	1.244 e+7	-	2.582e+7	0.867	-	2.221	1.224	-	2.122	$C_{21}H_{42}O_2$
Di(2-ethylhexyl)adipate	7.241e+6	5.209e+6	7.188 e+6	7.489 e+6	8.299 e+6	-	1.116	1.036	1.043	0.737	1.210	-	$C_{22}H_{42}O_4$
Bis(2-ethylhexyl) phthalate	2.558e+7	2.605e+7	2.952 e+7	3.084 e+7	2.778 e+7	2.042e+7	3.941	5.182	4.283	3.034	4.050	1.678	$C_{24}H_{38}O_4$
9-Octadecenamide, (Z)	1.561e+7	2.899e+7	1.143 e+7	1.402 e+7	9.950 e+6	-	2.405	5.766	1.658	1.379	1.451	-	$C_{18}H_{35}NO$
Phenol, 4-propyl	-	1.179e+7	2.214e+7	-	-	-	-	2.346	3.212	-	-	-	$C_9H_{12}O$
13-Octadecenoic acid, methyl ester	-	1.179e+8	-	-	-	-	-	23.454	-	-	-	-	$C_{19}H_{36}O_2$
Hexadecanoic acid, 15-methyl-, methyl ester	-	1.417e+7	-	2.206 e+7	-	-	-	2.818	-	2.170	-	-	$C_{18}H_{36}O_2$
Hentriacontane	-	9.817e+6	-	1.016 e+7	1.505 e+7	-	-	1.953	-	0.999	2.194	-	$C_{31}H_{64}$
Tritetracontane	-	1.080e+7	2.040 e+7	2.354 e+7	-	-	-	2.148	2.959	2.316	-	-	$C_{43}H_{88}$
Heneicosanoic acid, methyl ester	-	8.505e+6	-	-	-	-	-	1.692	-	-	-	-	$C_{22}H_{44}O_2$
Oleanitrile	-	3.350e+7	-	-	-	-	-	6.664	-	-	-	-	$C_{18}H_{33}N$
Phenol, 2-propyl	-	-	2.214e+7	-	-	-	-	-	3.212	-	-	-	$C_9H_{12}O$

Tridecanoic acid, 12-methyl-, methyl ester	-	-	3.185 e+7	-	-	4.079e+7	-	-	4.621	-	-	3.351	$C_{15}H_{30}O_2$
1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester	-	-	8.522 e+6	-	8.880 e+6	-	-	-	1.236	-	1.294	-	$C_{16}H_{22}0_4$
Hexadecanoic acid. methyl ester	-	-	1.020 e+8	-	-	1.993e+8	-	-	14.804	-	-	16.374	$C_{17}H_{34}O_2$
Hexadecanoic acid, ethyl ester	-	-	-	-	7.521 e+6	-	-	-	-	-	1.096	-	$C_{18}H_{36}O_2$
(R)-(-)-14-Methyl-8-hexadecyn-1-ol	-	-	1.086 e+7	-	-	-	-	-	1.576	-	-	-	$C_{17}H_{32}0$
Docosanoic acid, methyl ester	-	-	6.518 e+6	-	-	-	-	-	0.946	-	-	-	$C_{23}H_{46}O_2$
9,19-Cyclolanostan-3-ol,acetate, (3. beta.)	-	-	1.021 e+7	1.116 e+7	7.021 e+6	2.122e+7	-	-	1.482	1.098	1.023	1.990	$C_{32}H_{54}O_2$
beta.-Sitosterol	-	-	7.344 e+6	1.264 e+7	5.612 e+6	1.742e+7	-	-	1.064	1.243	0.818	4.431	$C_{29}H_{50}O$
9,19-Cyclolanost-24-en-3-ol, acetate	-	-	1.562 e+7	2.231 e+7	1.651 e+7	4.632e+7	-	-	2.267	2.195	2.407	3.806	$C_{32}H_{52}O_2$
2-Methoxy-4-vinylphenol	-	-	-	2.066e+7	-	-	-	-	-	2.032	-	-	$C_9H_{10}O_2$
3(2H)-Furanone, 2-hexyl-5-methyl	-	-	-	2.043 e+7	-	-	-	-	-	2.010	-	-	$C_{11}H_{18}O_2$
11,14-Octadecadienoic acid, methyl ester	-	-	-	3.144 e+8	-	-	-	-	-	30.929	-	-	$C_{19}H_{34}O_2$
(Z)6,(Z)9-Pentadecadien-1-ol	-	-	-	1.565 e+7	-	1.600e+7	-	-	-	1.539	-	2.958	$C_{15}H_{28}O$
Pentadecanoic acid, methyl ester	-	-	-	-	5.645 e+6	-	-	-	-	-	0.823	-	$C_{16}H_{32}O_2$
Tridecanoic acid, 12-methyl-, methyl ester	-	-	3.185 e+7	-	3.240 e+7	-	-	-	4.621	-	4.723	-	$C_{15}H_{30}O_2$
Methyl 11-hexadecenoate	-	-	-	-	6.816 e+6	-	-	-	-	-	0.994	-	$C_{17}H_{32}O_2$
Methyl 12,13-tetradecadienoate	-	-	-	-	2.272 e+8	-	-	-	-	-	33.121	-	$C_{15}H_{26}O_2$
Oleic Acid	-	-	-	-	7.245 e+6	-	-	-	-	-	1.056	-	$C_{18}H_{34}O_2$
Docosanoic acid, ethyl ester	-	-	-	-	1.494 e+7	-	-	-	-	-	2.178	-	$C_{24}H_{48}O_2$
9 12-Hexadecadienoic acid, methyl ester	-	-	-	-	-	5.011e+8	-	-	-	-	-	41.171	$C_{17}H_{30}O_2$
Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester	-	-	-	-	-	4.221e+7	-	-	-	-	-	3.469	$C_{19}H_{38}O_4$

ACM-*Allium cepa* methanol extract, ACA-*Allium cepa* acetone extract, ACEA-*Allium cepa* ethyl acetate extract, ACC-*Allium cepa* chloroform extract, ACPE-*Allium cepa* petroleum ether extract, ACB-*Allium cepa* benzene extract

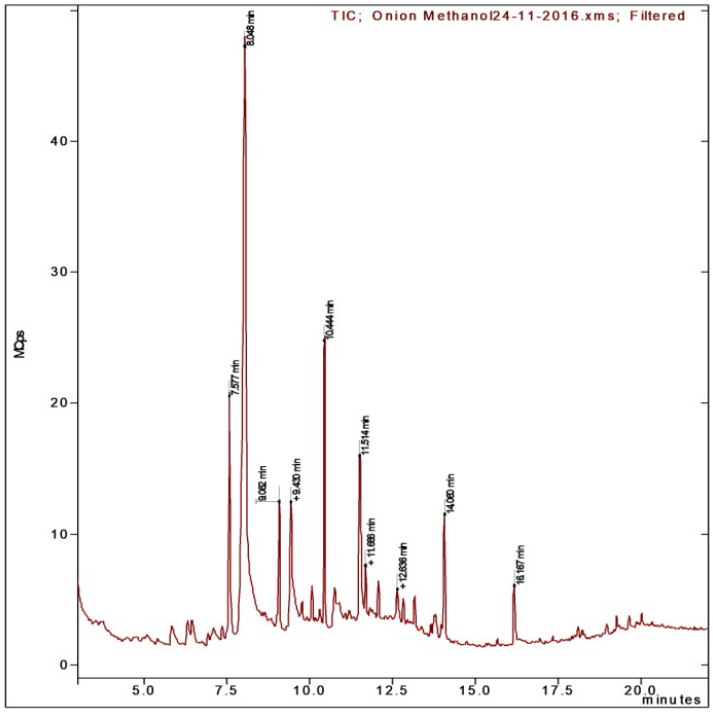

Fig. 1: GCMS spectra of methanol extract

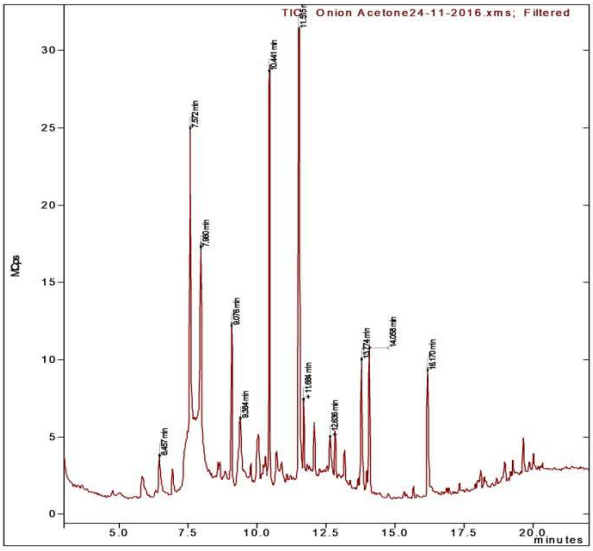

Fig. 2: GCMS spectra of Acetone extract

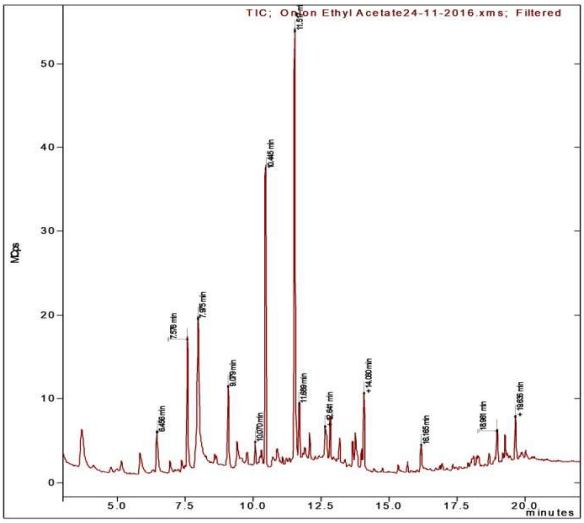

Fig. 3: GCMS spectra of ethyl acetate extract

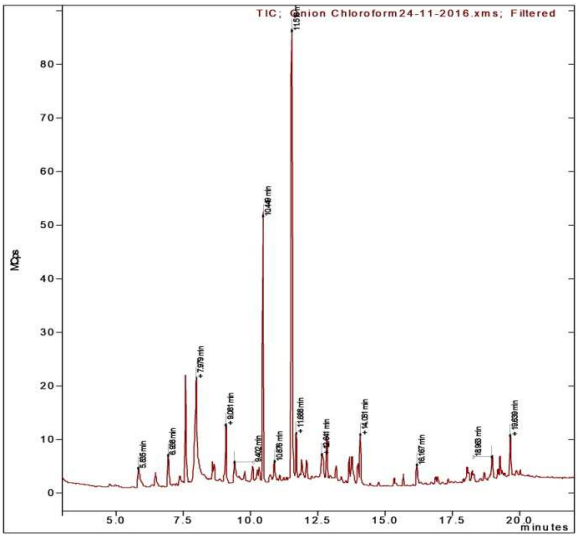

Fig. 4: GCMS spectra of chloroform extract

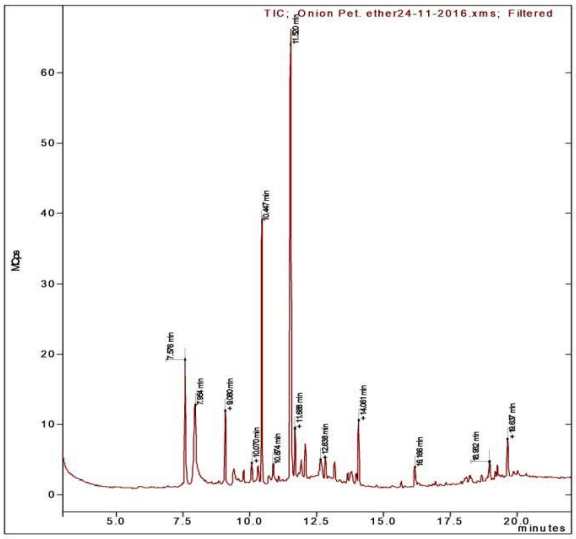

Fig. 5: GCMS spectra of petroleum ether extract

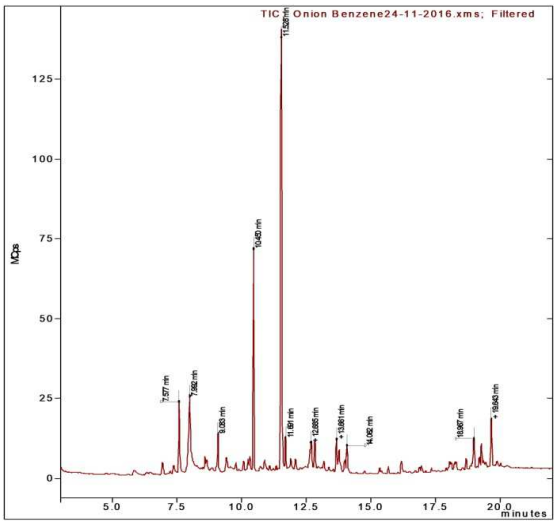

Fig. 6: GCMS spectra of Benzene extract

In this study, the common compounds identified were dodecanoic acid (methyl ester), dodecanoic acid and bis (2-ethylhexyl) phthalate in all the extracts. The maximum amount of dodecanoic acid was 44.86 % in methanol extract. The % of total dodecanoic acid (methyl ester) and bis (2-ethylhexyl) phthalate was comparable in all extracts which lies in the range of 6.284% to 12.91%. The highest antibacterial activity was found in methanol extract of *A. cepa* which may be due to the presence of higher amount of dodecanoic acid in comparison to other extracts. The highest antibacterial activity of methanol extract may also be due to the presence of volatile and non-volatile secondary metabolites. Further, research is required to study the effectiveness of purified active components from methanol extract of *A. cepa*.

CONCLUSION

It is concluded that *A. cepa* methanol extract has shown good antibacterial activity against different bacterial strains. GCMS analysis of different extracts revealed the presence of 43 phytochemicals. The findings of this work support the vision that this plant could provide biologically active natural drugs which may be useful for the treatment of bacterial infectious diseases.

ACKNOWLEDGEMENT

This research work was supported by grant from UGC BSR [F.4-1/2006 (BSR/7-371/2012] and UGC-SAP [F.20/2012(SAP-II)].

ABBREVIATIONS

ATCC: American Type Cell Culture, GCMS: Gas Chromatography Mass Spectrometry, MIC: Minimum Inhibitory Concentration.

AUTHORS CONTIBUTIONS

Dushyant Sharma has prformed experimentation work, data collection, and drafted the manuscript. Reena Rani has made significant involvement in the interpretation of data and revising the manuscript. Monika Chaturvedi participated in the design of the study and performed the statistical analysis. Jaya Parkash Yadav helped in designed the study and manuscript.

CONFLICT OF INTERESTS

There is no conflict of interest between authors.

REFERENCES

1. Pradeepa M, Kalidas V, Geetha N. Qualitative and quantitative phytochemical analysis and bactericidal activity of pelargonium graveolens L'her. Int J Appl Pharm 2016;8:7-11.
2. Ogunlowo OP, Arimah B, Adebayo M. Phytochemical analysis and comparison of *in vitro* antimicrobial activities of the leaf, stem bark and root bark of *Ficus benghalensis*. IOSR J Pharm 2013;3:33-8.
3. Sharma D, Yadav JP. An overview of phytotherapeutic approaches for the treatment of tuberculosis. Mini Rev Med Chem 2017;17:167-83.
4. Tyagi R, Sharma G, Jasuja ND, Menghani E. Indian medicinal plants as an effective antimicrobial agent. J Crit Rev 2017;3:69-71.
5. Keusgen M, Fritsch RM, Hisoriev H, Kurbonova PA, Khassanov FO. Wild Allium species (Alliaceae) used in folk medicine of Tajikistan and Uzbekistan. J Ethnobiol Ethnomed 2006;2:1-9.
6. Benkeblia N, Lanzotti V. Allium thiosulfinates: chemistry, biological properties and their potential utilization in food preservation. Food 2007;1:193-201.
7. Lanzotti V. The analysis of onion and garlic. J Chromatogr A 2006;1112:3-22.
8. Mnayer D, Fabiano-Tixier AS, Petitcolas E, Hamieh T, Nehme N, Ferrant C, *et al*. Chemical composition, antibacterial and antioxidant activities of six essentials oils from the Alliaceae family. Molecules 2014;19:20034-53.
9. Chinnala KM, Achant P, Vangala VL, Elsani MM. Evaluation for nephroprotective activity of ethanolic extract of *Allium cepa* linn. In gentamicin-induced nephrotoxicity in rats. Asian J Pharm Clin Res 2017;10:356-9.
10. Jalaiah M, Sarvanan R, Gowtham CH, Vinay Y, Akhila Y. Evaluation of cardioprotective activity of *Allium cepa* aerial leaves. Int J Curr Pharm Res 2017;9:27-30.
11. Almawlah YH, Alaa H, Al-Jelawi SO. Antibacterial activity of three plant extracts against multidrug resistance *Pseudomonas aeruginosa*. Asian J Pharm Clin Res 2017;10:193-7.
12. Shabana S, Kawai A, Kai K, Akiyama K, Hayashi H. Inhibitory activity against urease of quercetin glycosides isolated from *Allium cepa* and *Psidium guajava*. Biosci Biotechnol Biochem 2010;74:878-80.
13. Arung ET, Furuta S, Ishikawa H, Kusuma IW, Shimizu K, Kondo R. Anti-melanogenesis properties of quercetin-and its derivative-rich extract from *Allium cepa.* Food Chem 2011;124:1024–8.
14. Perez-Gregorio RM, Garcia-Falcon MS, Simal-Gandara J, Rodrigues AS, Almeida DP. Identification and quantification of flavonoids in traditional cultivars of red and white onions at harvest. J Food Comp Anal 2010;23:592-8.
15. Perez C, Pauli M, Bazerque P. An antibiotic assay by agar well diffusion method. Act Biol Med Exp 1990;15:113-5.
16. Sarker SD, Nahar L, Kumarasamy Y. Microtitre plate-based antibacterial assay incorporating resazurin as an indicator of cell growth, and its application in the *in vitro* antibacterial screening of phytochemicals. Methods 2007;42:321-4.
17. Palaksha MN, Banji D, Rao AS. In vitro evaluation of antibacterial activity of alcoholic extracts of ten South Indian spices against multi-resistant gram-positive and gram-negative bacteria by agar well diffusion method. World J Pharm Pharm Sci 2013;2:3840-7.
18. Griffiths G, Trueman L, Crowther T, Thomas B, Smith B. Onions-a global benefit to health. Phytother Res 2002;16:603-15.
19. Sable MG, Puttewar TY, Patil RY. Investigation of antibacterial activity of *Allium cepa* (onion) *Zingiber officinale* (Ginger). Int J Curr Res 2014;6:8768-78.
20. Shinkafi SA, Dauda H. Antibacterial activity of *Allium Cepa* (Onion) on some pathogenic bacteria associated with ocular infections. Schol J Appl Med Sci 2013;1:147-51.
21. Kim WJ, Lee KA, Kim KT, Chung MS, Cho SW, Paik HD. Antimicrobial effects of onion (*Allium cepa* L.) peel extracted by subcritical water. Food Sci Biotech 2011;20:1101-6.
22. Shakurfow FA, Buazzi MM, Gamal MA. Assessment of antimicrobial activity of onion (*Allium cepa*) and garlic (*Allium sativum*) extracts on *Listeria monocytogenes*; *in vitro* study. Lebda Med J 2016;1:1-5.
23. Santas J, Almajano MP, Carbo R. Antimicrobial and antioxidant activity of crude onion (*Allium cepa*, L.) extracts. Int J Food Sci Tech 2010;45:403-9.
24. Nitbani FO, Siswanta D, Solikhah EN. Isolation and antibacterial activity test of lauric acid from crude coconut oil (*Cocos nucifera* L.). Proc Chem 2016;18:132-40.
25. Pundir RK, Jain P. Evaluation of five chemical food preservatives for their antibacterial activity against bacterial isolates from bakery products and mango pickles. J Chem Pharm Res 2011;3:24-31.
26. Odiba JO, Musa AM, Hassan HS, Yahay SM, Okolo EI. Antimicrobial activity of isolated stigmast-5-en-3-β-ol (β-sitosterol) from honeybee *Propolis* from North-Western, Nigeria. Int J Pharma Sci Res 2014;5:908-18.
27. Lekshmi PNCJ, Viveka S, Viswanathan MB, Manivannan G, Shobi TM. GC-MS Characterization of Volatile Odorous Compounds in *Allium Cepa*. Nanobiol Pharm Tech 2014;488-94. DOI:10. 13140/2.1.3278.7523.
28. Farag MA, Ali SE, Hodaya RH, El-Seedi HR, Sultani HN, Laub A, *et al*. Phytochemical profiles and antimicrobial activities of *Allium cepa* red cv. and *Allium sativum* subjected to different drying methods: a comparative MS-based meta-bolomics. Molecules 2017;22:1-18.